ENGINEERING SOILS MAP OF MADISON COUNTY, INDIANA

001493

SEPTEMBER 1968

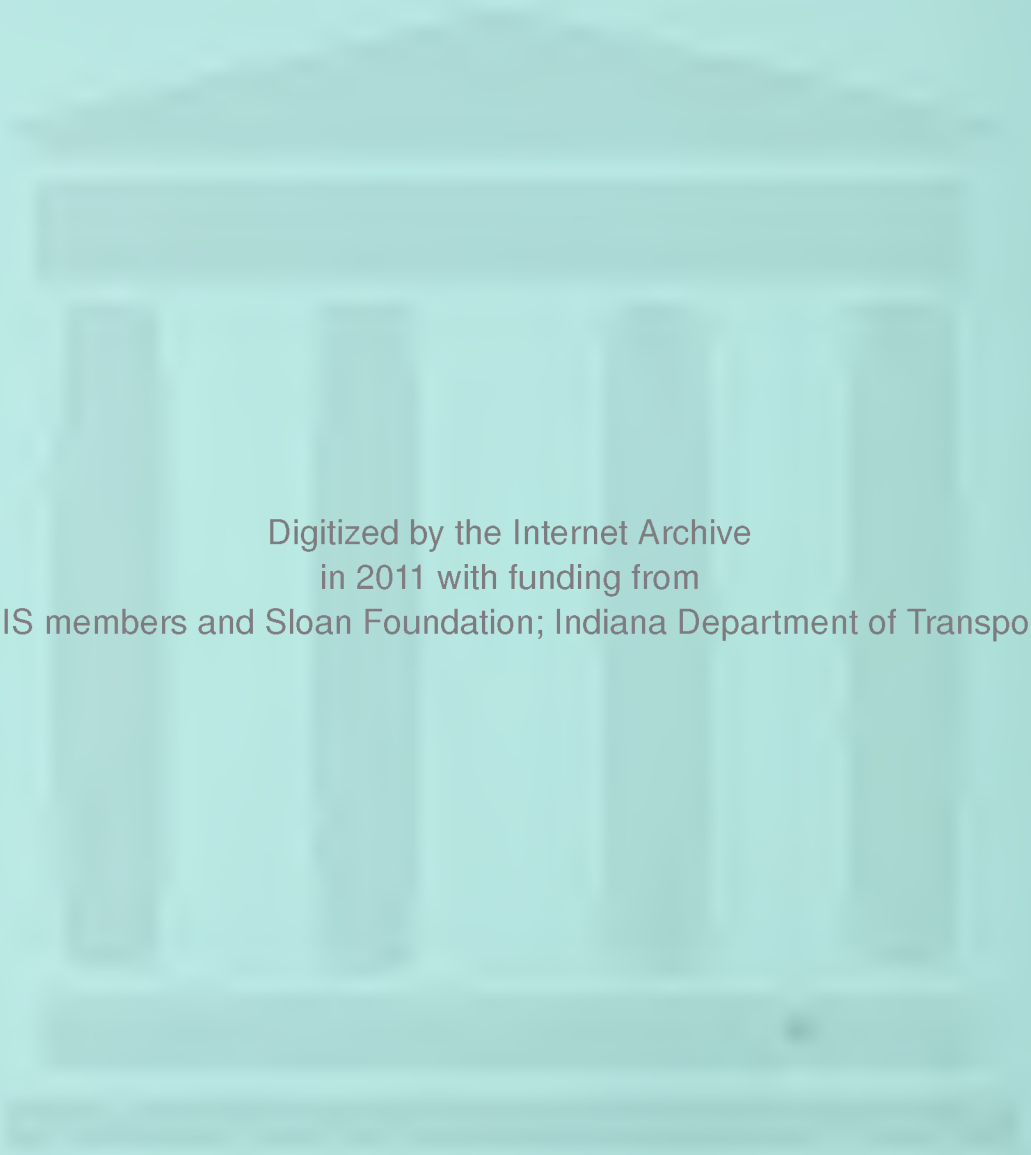
NO. 25

by

D. G. SHURIG

Joint Highway Research Project

PURDUE UNIVERSITY
LAFAYETTE INDIANA



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Final Report

ENGINEERING SOILS MAP OF MADISON COUNTY INDIANA

TO: Dr. J. F. McLaughlin, Director
Joint Highway Research Project

September 12, 1968

File: 1-5-28-46

FROM: H. L. Michael, Associate Director
Joint Highway Research Project

Project: C-36-51B

The attached report, entitled "Engineering Soils Map of Madison County, Indiana," completes a portion of the project concerned with development of county engineering soils maps of the State of Indiana. This is the 46th report in the series. The report was prepared by Professor Donald G. Shurig, Joint Highway Research Project.

The soils mapping of Madison County was performed primarily by using the soil survey map sheets published by the Soil Conservation Service, United States Department of Agriculture in the Soil Survey of Madison County. Airphoto interpretation techniques were used to supplement the pedological data. The resulting Engineering Soils Map is presented as a blackline print.

Respectfully submitted,

Harold L. Michael
Associate Director

HLM:sb

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Final Report

ENGINEERING SOILS MAP OF MADISON COUNTY

by

D. G. Shurig
Research Associate

Joint Highway Research Project

Project No: C-36-51B
File No: 1-3-28-46

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

in cooperation with the

Indiana State Highway Commission

and the

Soil Conservation Service

U. S. Department of Agriculture

Purdue University
Lafayette, Indiana
September 13, 1968

ENGINEERING SOILS MAP
OF
MADISON COUNTY, INDIANA

by

D. G. Shurig

INTRODUCTION

Development of an engineering soils map of Madison County was the primary goal of this project. The map is appended to this report; the report supplements the engineering soils map information.

The detailed pedological soils maps published in the 1967 Soil Survey of Madison County by the United States Department of Agriculture were the single most important source of data used in the project. These agricultural soils map sheets, at a scale of 1:15,840, were assembled to form a mosaic map of Madison County. Careful study of the soil series descriptions enabled the grouping of the series into appropriate land form and parent material categories. Preliminary land form and parent material boundaries were then delineated on the mosaic-map.

Routine airphoto interpretation techniques supplemented the pedological data. Aerial photographs were examined and the preliminary boundaries checked and modified, if necessary, to produce final land form and parent-material boundaries. The photographs were contact prints at an approximate scale of 1:200,000. Date of photography was 1939.

The final land form and parent material boundaries were graphically reduced to produce the engineering soils map. Symbols were used to

delineate the parent materials as grouped according to land form and origin. Textural symbols were superimposed to indicate the relative compositions of the parent materials. The map also includes a set of soil profiles which indicate the general soil profiles of topographically high and low sites in each parent material area. Each profile shows the general range in depth and texture (ISHC textures) of each soil horizon. Because of the obviously bad construction characteristics of highly organic topsoils, these materials were carefully mapped. However, not all of the identifiable areas of these materials were large enough to be shown on the relatively small scale engineering soils map.

DESCRIPTION OF AREA

GENERAL

Madison County is located in the east central part of Indiana (Figure 1). Anderson, the county seat, is 35 miles northeast of Indianapolis.

County dimensions are 30 miles in the north-south direction and 15 miles east-west. The area is 453 square miles.

At the last census, 1960, the total county population was 125,819 with 64 percent urban and 36 percent rural. The City of Anderson had a population of 49,061 in 1960 (1).

Madison County is important for farming, though there is a trend toward urbanization. Farming is generally of the cash, grain-livestock type (1).

DRAINAGE FEATURES

The central part of Madison County is drained by the West Fork White River and its tributaries Pipe Creek, Indian Creek, and Kilbuck Creek and Little Kilbuck Creek (Figure 2) (2). Except for these three small streams the West Fork White River collects most of its water from other areas as it flows east-west across the county.

The northeastern part of the county is drained primarily by Pipe Creek and several very short tributories: Mud Creek, Lilly Creek and Little Buck Creek which start from a level, marshy, black land as a series of ditches and drains before joining West Fork White River.

The southern part of the county is drained primarily by Fall Creek and Lick Creek which are essentially parallel before they join in the southwest corner of the county.

Except for West Fork White River, which flows east-west, essentially all the streams flow generally southwest.

It can be noted in Figure 2, that the density of streams and ditches in the northwest and southwest is somewhat less than that of the rest of the county.

When there were large volumes of meltwater from the receding glaciers, sluiceways were cut and the channel size is considerably larger than necessary for the streams presently flowing in the channels. Small underfit streams include the following creeks: Mud, Pipe, Kilbuck, Little Kilbuck, Stoney, Sly Fork, Prairie, Lick and Fall. In nearly all these old sluiceways, and especially in their upper reaches, drainage ditches have been developed to concentrate the flow of runoff water.

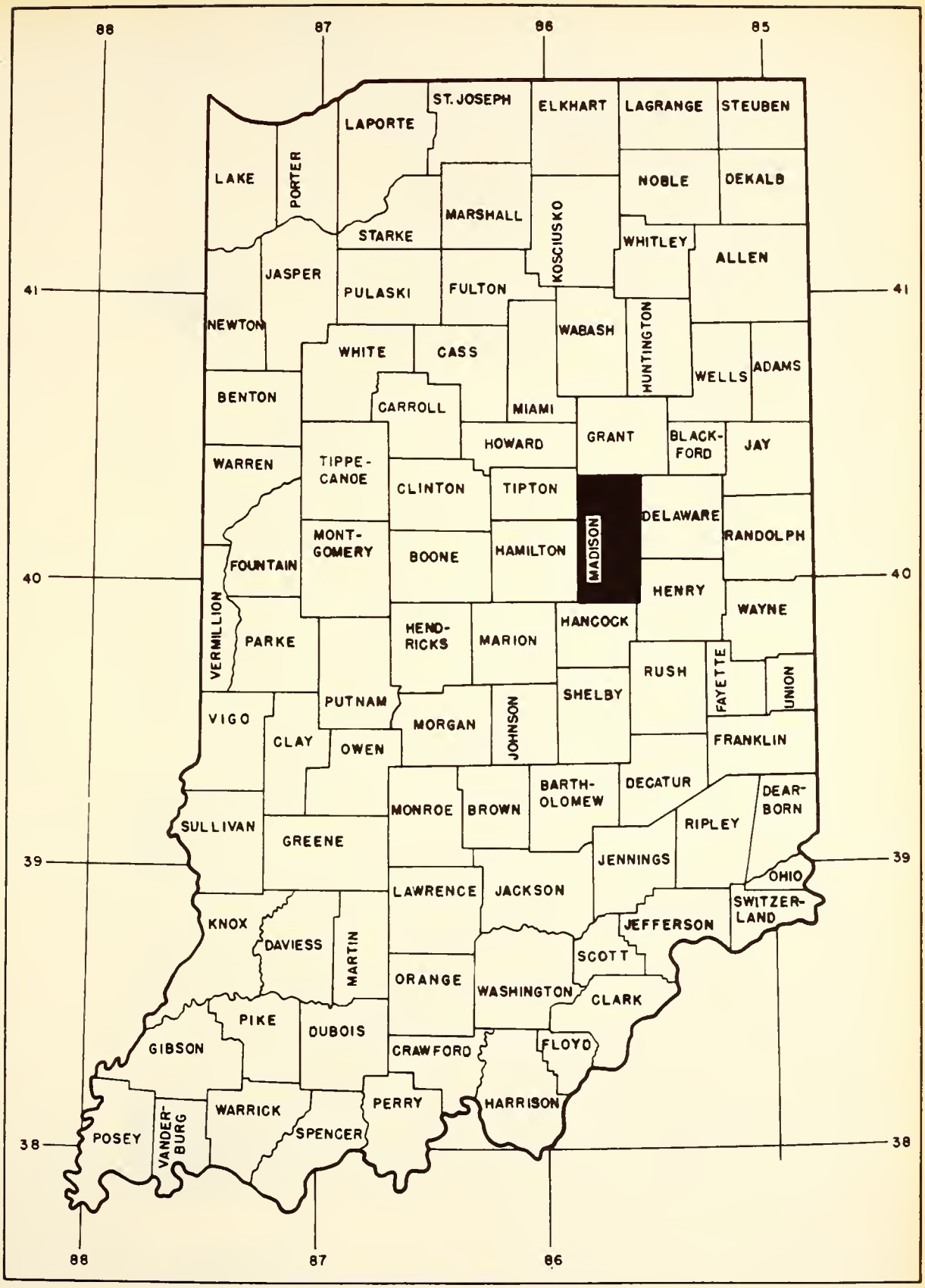


FIG. 1. LOCATION MAP OF MADISON COUNTY

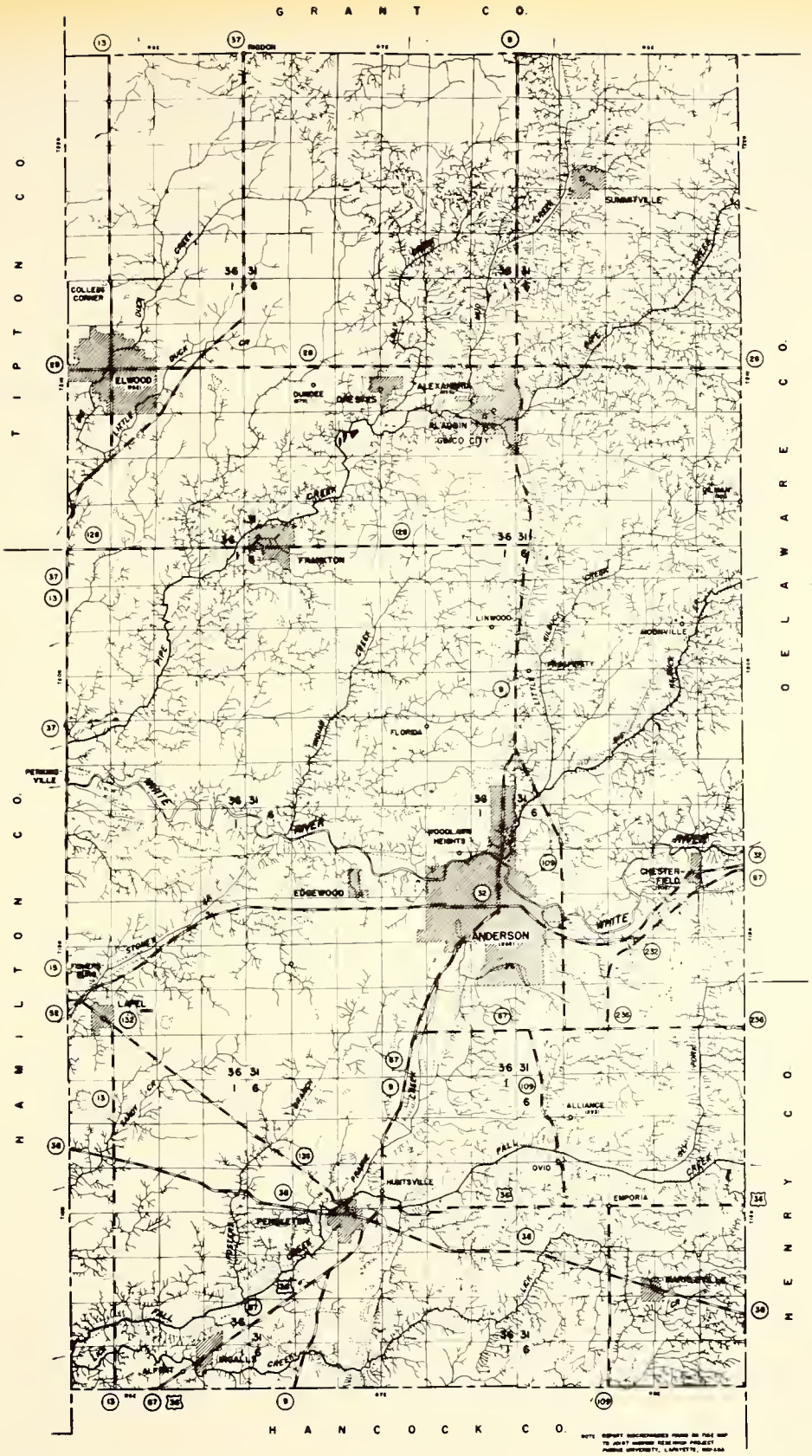


FIG. 2 DRAINAGE MAP

MADISON COUNTY

INDIANA

CLIMATE

The climate of Madison County is continental, temperate and humid. The generally warm humid summers and moderately cold winters are characterized by frequent sudden changes of temperature. The wide variations occuring within a season are indicated by the absolute minimum and absolute maximum temperatures listed in Table I (1).

GLACIAL GEOLOGY

Ice covered Madison during at least three glacial ages: Kansan, Illinoian and Wisconsin. The thickness of the glacial drift deposited ranges from no cover, at a few bedrock exposures, to more than 250 feet over some preglacial valleys (see figure 3) (3).

Wisconsin drift appears on the surface and it includes drift deposited during two sub-ages - the Tazewell, and the Cary. (3)

The Tazewell-Cary interglacial period lasted 10,000 to 12,500 years. The Tazewell ice sheet was comparatively large and covered all of Madison County. The Cary ice sheet, in Indiana, was a comparatively small lobe— the Huron-Erie Lobe-and covered only the northeast corner of the county. The Huron-Erie Lobe reached only into the northeast corner of Madison County forming the Union City terminal moraine running northwest-southeast across the northeast corner of the county.

The Huron-Erie Lobe, being more sharply confined to the lacustrine plains to the northeast, deposited generally finer materials, namely clay, than the earlier and larger Tazewell ice sheet. The following Tazewell and Cary till descriptions (for Wabash County to the north) by Wayne and Thornbury point up some of the differences between the older and younger tills.

TABLE I

Average Monthly and Annual Temperatures and

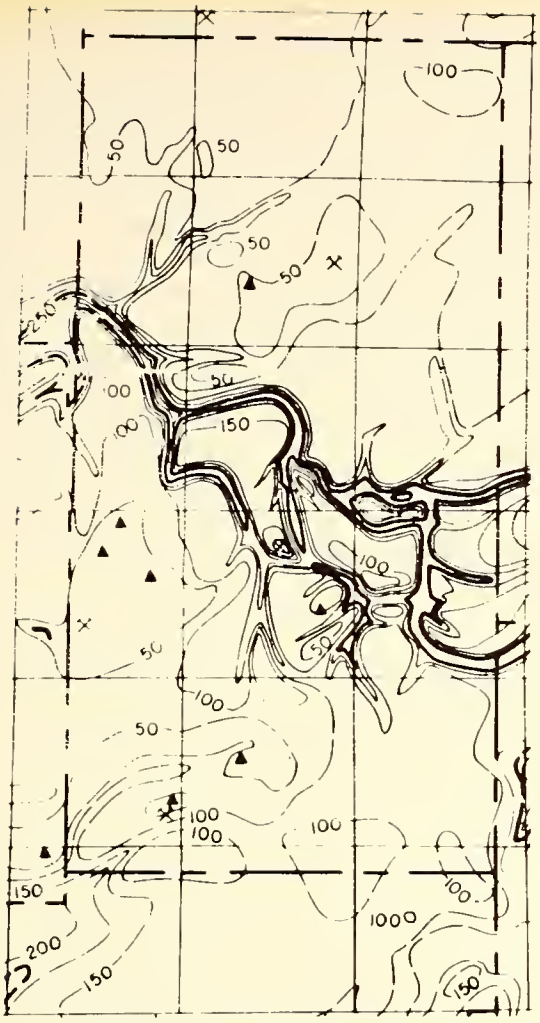
Precipitation at Anderson in Madison County, Indiana

(Highest Elevation in Anderson is 874 Feet)

Month	Temperature			Precipitation		
	Average Deg. F	Absolute Max. Deg.	Absolute Min. Deg.	Average Inches	1 in 10 yrs. less than	1 in 10 yrs. more than
Jan.	29	69	-20	2.6	0.7	5.9
Feb.	31	72	-19	1.9	0.6	3.4
Mar.	41	85	-5	3.4	1.6	6.3
Apr.	52	90	18	3.6	1.9	5.9
May	62	96	28	4.1	1.7	6.9
June	71	103	36	4.0	1.6	7.7
July	75	105	42	3.7	1.2	6.4
Aug.	73	103	39	3.5	1.6	5.5
Sept.	68	103	26	3.3	0.8	6.4
Oct.	56	92	15	2.6	0.9	4.8
Nov.	43	81	-4	2.9	1.2	4.9
Dec.	32	68	-15	2.4	0.6	4.2
Year	53	105	-20	38.0	30.4	45.8

"Unweathered Tazewell till is pale gray, bouldery, calcareous and generally contains a large amount of quartz sand which appears to decrease in quantity southward.

"Cary till is heavy textured, dark gray, blocky and clayey. It commonly breaks with a nearly cubic fracture and when moist is much more plastic than earlier till. Sand-size material is sparse throughout, and few cobbles and boulders are present." (4)

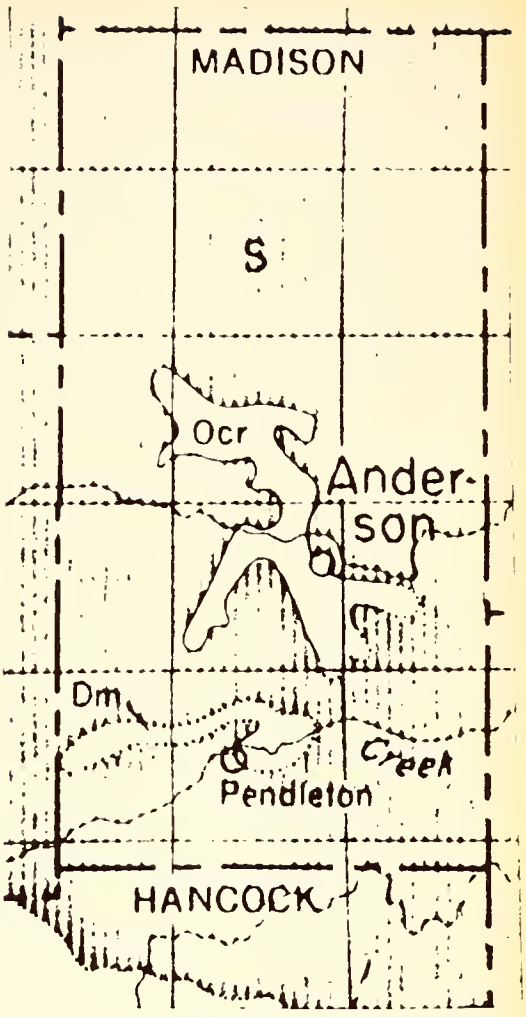


GLACIAL DRIFT THICKNESS
(WAYNE-1956)

50 Ft. Contour Interval

▲ Bedrock Outcrop

⚒ Quarry



BEDROCK GEOLOGY
(PATTON-1956)

Dm Middle Devonian

S Silurian Limestone Dolomite, and Shale

Ocr Ordovician

Figure 3. Glacial drift thickness map and bedrock geology map of Madison County. Maps indicate that a branch of the preglacial Teays River had cut through Silurian bedrock into upper Ordovician bedrock.

Some earlier geology and soil reports indicate that the Mississinewa Moraine, just northeast of the Union City Moraine, marks the fartherest advance of the Huron-Erie Lobe. However, the Soil Survey of Madison County, Indiana (1967), shows lakebed clay, namely Pewamo, Blount and Morley, extends from northeast of Fort Wayne down to and including the Union City Moraine (1). South of the Union City Moraine, Miami, Crosby and Brookston soils predominate. It is thus more likely that the Huron-Erie Lobe reached a little farther south than many earlier reports indicate.

As the Cary ice sheet melted back, small outwash plains of silt and fine sand developed in the northwest quadrant of the county. In other areas sluiceways formed to carry away large volumes of meltwater. Occasionally sluiceways and rivers crossed and overflow produced more outwash plains and shallow outwash on till. After runoff of the meltwater some of the north-south and northeast-southwest drainage ways wereabandoned and filled with fine-to coarse-grained outwash. The filled and abandoned sluiceways are called valley train land forms.

BEDROCKS GEOLOGY

Figure 3 shows a generalized bedrock geology map of Madison County and the approximate depth of overburden (5). Most of the bedrock is Silurian limestone and shale. Preglacial erosion has cut through to Ordovician rocks in the central part of the county. Above the predominating mass of Silurian rocks a very small remnant of middle Devonian rocks (limestone and sandstone) remains in the southern part of the county. Some Devonian sandstone is reported to crop out at the foot of a waterfalls just south of Pendleton.

There are two large quarries in Madison County that produce crushed limestone aggregate. The quarry at Lapel shows the following section: 12 feet of drift, 98.6 feet of Huntington facies, (mostly dolomite) and

51.8 feet of Louisville limestone. A newly opened quarry, 3.6 miles south of Anderson, has reportedly exposed 16 feet of Devonian limestones (6).

PHYSIOGRAPHY AND TOPOGRAPHY

Madison County lies in the Central Lowlands province of the United States and in the Till Plains section of the province. In Indiana the Till Plains section is known as the Tipton Till Plains.

The topography of Madison County is gently undulating. Monotonously featureless till plains and outwash plains are broken only by stream erosion and a low, weakly developed, ridge moraine crossing the northeast part of the county.

Average relief on the till plain is about five feet. The gently sloping Union City ridge moraine rises only about 30 feet above the large expanse of till plain to the south. Postglacial streams have cut valleys about 40 feet deep into the glacial drift. Thus, the areas of highest relief are adjacent to major streams where erosion and dissection are strongest. The streams have cut a few feet into bedrock in a small number of places but there is no land form expression due to bedrock.

An outstanding land form is an esker several miles long lying in a slough extending southerly from Anderson.

In the southern part of the county there are scattered outwash plain areas which blend topograpically into terraces along streams, and on the other side of the outwash plain areas, outwash materials form thin deposits over gently undulating till plain materials.

The highest point in the county is the southeast corner and has an elevation of approximately 1,010 feet. The highest elevation in Anderson is about 874 feet, in Alexandria - about 855 feet, and in Elwood about

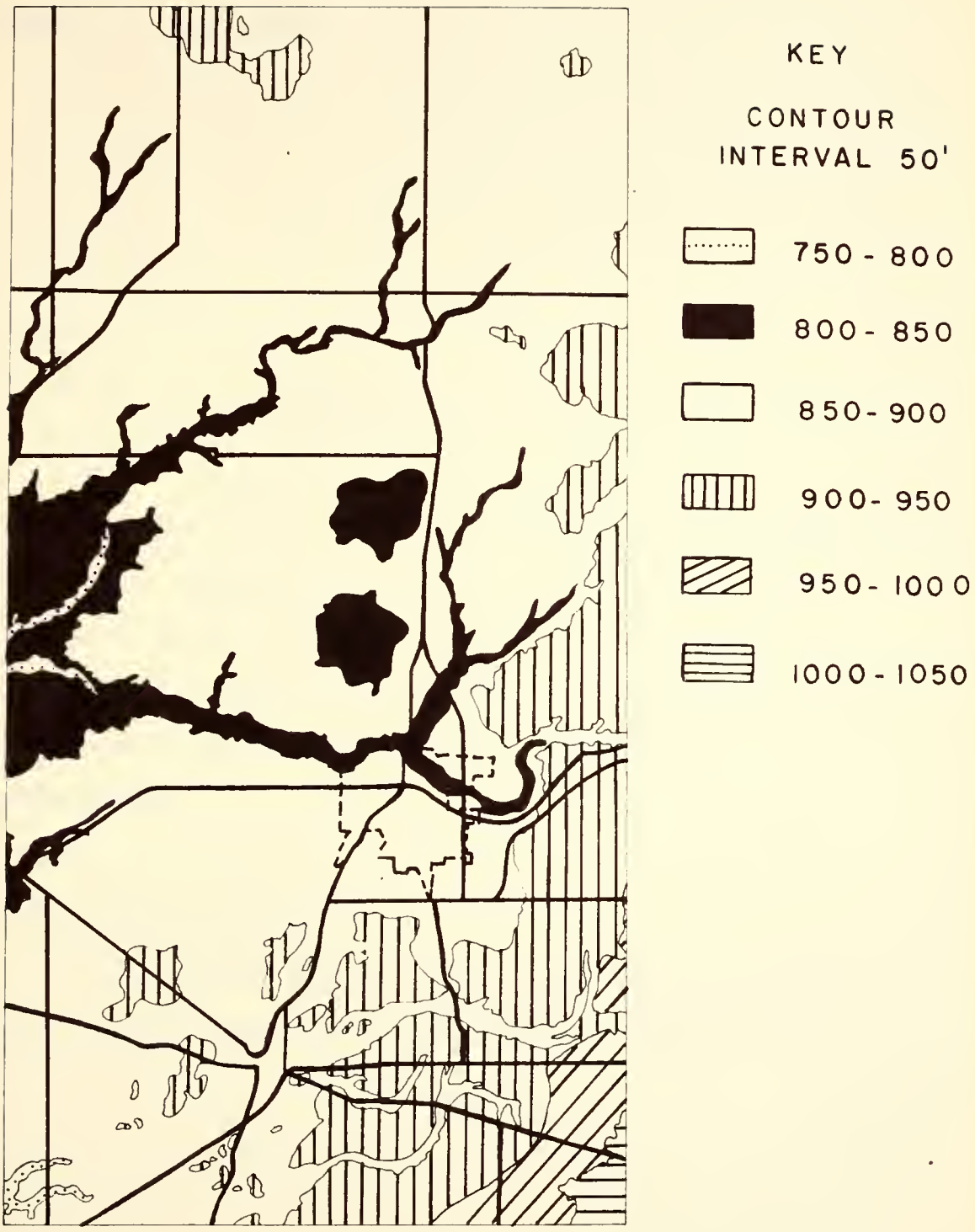


FIG. 4 : TOPOGRAPHIC MAP OF MADISON CO.

862 feet. The lowest point is in the southwest corner of the county and is approximately 800 feet. Figure 4 shows a contour map of Madison County with a contour interval of 50 feet.

Over half the county ranges in elevation between 850 and 900 feet above sea level datum. Less than two percent of the area is above 1000 feet of elevation. River valleys leave the county at elevations just below 800 feet.

ENGINEERING SOIL AREAS

The soils of Madison County can be divided into three major groups: (1) glacial or ice-contact deposits (2) fluvial or water-deposited materials and (3) miscellaneous deposits. In the discussion that follows each of the major groups is further subdivided into land form parent-material groups. These groups are then subdivided into soil textural groups.

I. GLACIAL DEPOSITED MATERIALS

The land forms of glacial, or ice-contact deposits in Madison County include ground moraines, ridge moraines, eskers and kames.

(1) Ground Moraine - Clayey and Silty Textures

By far the greatest area of Madison County is covered with gently undulating ground moraine. All the ground moraine southwest of the Union City ridge moraine is slightly less clayey and less plastic than the ground moraine northeast of the ridge moraine. The parent material of the larger ground moraine area is primarily a clay loam or loam.

It is reported (1) that the surface soils are mainly wind blown silts and range in thickness from 0 to 18 inches. The B horizon is usually a plastic to highly plastic clay and ranges in thickness from about 15 to 45 inches.

Pedologically the soils are predominently Brookston, Crosby and Miami. The last page of this report shows considerable engineering soil test data for the horizons of the Brookston and Miami soils for specific areas sampled in Madison County.

(2) Ridge and Ground Moraine - Clayey Texture

The Union City moraine, running northwest-southeast across the northeast corner of the county, is a low, poorly developed and poorly defined ridge moraine. The towns of Ridgon and Summitville are on the moraine and Alexandria is on the south edge. The ridge moraine is no more than 30 feet higher than the large ground moraine area to the southwest. To the northeast a small ground moraine is associated with the ridge moraine.

The material of the Union City moraine, as well as the ground moraine in the northeast corner of the county, is a clay from the former glacial lakes in the northern part of Indiana and Ohio. The soils in the

northeast part of the county thus contain more clay than soils in the rest of the county. Parent materials in the northeast are clays and clay loams. Pedologically these soils are the Pewamo, Blount and Morley. Considerable engineering soil test data can be found on these soils in the Allen County soils report (7).

(3) Eskers and Kames

South of Anderson and trending nearly north and south is a long, narrow, relatively straight esker. The northern three miles of the esker lies on the eastern side of an abondoned glacial sluiceway up to three quarters of a mile wide in places. The sluiceway and esker parallel Indiana Route 9. The esker is extensively mined for sand and gravel. The northern three miles of the esker, is continuous and shows a sharply crested, inverted V-shape.

The southern three to four miles of the esker, between Fall Creek and Lick Creek, is more segmental, not as sharply crested and lies in a less poorly defined sluiceway.

There are several kames and/or crevasse fillings adjacent to the esker.

The stratified sand and gravel parent material of the eskers and kames is encountered at a depth of 4 to 42 inches. The gravel content ranges from about 45 to55 percent, mostly of the smaller gravel sizes, and a sample might show 35 to 55 percent sand and 0 to 10 percent fines.

II. FLUVIAL DEPOSITED MATERIALS

The fluvial deposited soils in Madison County are grouped and tabulated below according to their land form and parent material texture.

Valley Train
- Sand and Gravel
- Sand and Gravel over Limestone Bedrock
- Silt and Fine Sand
- Peat and Muck
- Highly Organic Topsoil

Alluvial Plain
- Silt and Sand

Terrace
- Sand and Gravel

Outwash Plains
- Sand and Gravel
- Shallow Outwash on Till
- Silt and Fine Sand

There are several abondoned glacial sluiceways or channels in Madison County that do not carry permanent streams. They do not have significant deposits of recent alluvium nor do they have terrace-type of land forms. The sluiceways were cut and back-filled by the latest glacial melt waters. The land form of the back-filled sluiceway or valley is designated a valley train.

Valley train terraces, or simply terraces, are found in those valleys where recent streams have dissected the valley train deposits. In these areas recent alluvial deposits are also found at the base of the terraces on the flood plains.

(1) Valley Train Sand and Gravel Texture

The larger valley train deposits of sand and gravel in Madison County are located as follows: in the northeast quadrant in the upper reaches of Pipe Creek: in the east-central part of the county along the upper reaches of Little Kilbuck and Kilbuck Creek; in the southeast quadrant along Sly Creek, Lick Creek and Spring Branch of Fall Creek.

The parent material in the valley train classifies as a gravelly sand. The range may vary from 55 to 75 percent sand, 25 to 35 percent gravel and 0 to 10 percent fines. The gravelly sand is usually overlain by 24 to 70 inches of silt loam and/or silty clay loam. The water table is relatively near the surface.

(2) Valley Train -- Sand and Gravel on Limestone Bedrock

In some of the old glacial sluiceways there are several areas, up to one-half square mile, where limestone bedrocks is located 18 to 42 inches below a loamy outwash material. In the sluiceways along Stoney Creek in the west central part of the county three shallow limestone areas are indicated on the map. There are four such areas south and southwest of Anderson in the sluiceways between West Fork White River and Fall Creek. Occasionally the larger streams in the county such as Fall Creek have cut into and exposed bedrock of limestone, sandstone and shale.

At least three large limestone quarries and numerous sand and gravel pits, in Madison County, make the supply of aggregate plentiful.

(3) Valley Train — Silt and Fine-Sand Texture

The larger valley train deposits of silt and fine sand are located in the upper reaches of the following creeks: Mud and Lilly in the northeast quadrant; Big Duck in the northwest quadrant; and Indian, Stoney and Fosters Branch in the southwest quadrants.

The parent material, some 39 to 60 inches deep, is composed of thin layers of fine sand and silt and a small amount of gravel and clay. The water table is at or very near the surface.

(4) Valley Train — Peat, Muck and Highly Organic Topsoil

A number of the old glacial sluiceways contain fairly large deposits of peat and muck and these naturally grade into organic topsoil deposits around their edges.

The largest peat and muck deposit lies in a narrow sluiceway extending from near Alexandria southward to Anderson. The next largest deposit lies in the valley of Sly Creek east of Anderson. There are a few large deposits in the sluiceway south of Anderson. This sluiceway, however, contains primarily organic topsoil. Other smaller peat and muck deposits are found infrequently scattered over the south half of the county in sluiceways, on outwash plains and a few on the ground moraine.

(5) Alluvial Plains

The West Fork White River, running east-west across the central part of the county has the greatest area of alluvial plains and associated sediments. Pipe Creek, flowing southwest in the northern half of the county exhibits extensive alluvial plains. Fall Creek, Lick Creek, Killbuck and Duck Creeks show relatively smaller alluvial plain areas in descending order.

(6) Terraces

The majority of terraces in Madison County are not sharply defined topographically. They are usually less than ten feet above the floodplains and are frequently scarred with small fluves.

The largest and best developed terraces are found along Pipe Creek, West Fork White River and along Fall Creek.

The parent material is usually dirty, stratified sand and gravel with the gravel being composed mainly of the smaller sizes. There are usually about equal quantities of sand and gravel with up to 10 percent fines and sometimes up to 20 percent fines. Overburden ranges from 24 to 70 inches (1).

Taylor (8) reports the following on sand and gravel deposits (namely terraces) in Madison County:

"The average sizes for the sand and gravel and the average rock percentages are as follows:

Percent	Material Size	Percent	Rock Composition
10	Clay	84	limestone
15	fine medium sand	10	crystallines
15	medium sand	2	shale
19	coarse sand	2	chert
22	roofing pebble	2	slate"
17	gravel		
2	boulder		

(7) Outwash Plains -- Sand and Gravel Texture

The sand and gravel textured outwash plains are conspicuously located at the confluence of old glacial meltwater streams. Note the outwash plain area northeast of Anderson that is about four miles by

three-quarters miles centering around the confluence of Kilbuck and Little Kilbuck Creeks.

At the intersection of the wide sluiceway south of Anderson and the valley of Fall Creek, large outwash plains formed both north and south of Fall Creek. Outwash was spread over an area nearly six miles long in the north-south direction and two to three miles wide in the east-west direction.

Where the West Fork White River and Pipe Creek join on the west central side of the county is another fairly large (about one square mile) sand and gravel outwash plain.

The parent material of the sand and gravel outwash plains is similar to the terrace materials. It is a dirty sand and gravel with the amounts of sand and gravel being about equal and with the gravel size relatively small. The silty and clayey overburden ranges from 24 to 70 inches.

(8) Outwash Plain — Shallow Outwash on Till

Along parts of some of the old glacial sluiceways, and associated with the previously described sand and gravel outwash plains, are very thin deposits of outwash material on till. Along the sides of sluiceways where the terrain has been somewhat dissected the thin outwash is found on gently rolling to hilly terrain. It is sometimes on the valley walls above stream terraces. When on ground moraine, the gently undulatinge character of the ground moraine is apparent along with characteristic infiltration basins of outwash plains.

The outwash material on till is relatively shallow and is usually found at a depth of 18 to 36 inches. The surface soil is loam.

(9) Outwash Plains — Silty and Fine Sandy Texture

The predominantly silty outwash plains considered here lie mainly in the northwest quadrant of the county. They are located adjacent to, and south of, the relatively fine-grained Union City ridge moraine. The four larger ones range in size from about one to three square miles. Several other smaller outwash plain areas are located on both sides of the West Fork White River.

The parent material is stratified silt and fine sand with small amounts of gravel and clay in some places. Depth to the parent material ranges from 39 to 70 inches. The A horizon ranges from silt loam to clay while the B horizon is usually a silty clay or clay. The water table is usually very near the surface.

TABLE 2. *Engineering test data for soil samplestaken from nine soil profiles, Madison County, Ind.*

[Tests performed by Purdue University in cooperation with the Indiana State Highway Dept. and the Bureau of Public Roads (BPR) Except for determining the California bearing ratio (CBR), tests were performed in accordance with standard procedures of the American Association of StateHighway Officials (AASHO)]

Soil name and location	Parent material	SCS report No.	Depth	Horizon	Moisture-density [1]		CBR test [2]			Mechanical analysis [3]													Liquid limit	Plasticity index	Classification	
							Molded specimen			Percentage passing sieve—									Percentage smaller than—							
					Maximum dry density	Optimum moisture	Dry density	Moisture content	CBR	Swell	3 in.	1½ in.	1 in.	¾ in.	⅜ in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO	Unified [4]
		SCI Ind-48-	*Inches*		*Lb. per cu. ft.*	*Percent*	*Lb. per cu. ft.*	*Pct.*	*Pct*	*Pct*																
Brookston silty clay loam:																										
SE¼NE¼ sec. 23, T. 18 N., R. 6 E. (modal).	Late Wisconsin glacial till.	7–1	[3]0–9	Ap	101	18	101.5	18.4	6	1.18						100	99	96	81	78	65	39	30	44	18	A–7–6(12)	ML–CL.
		7–2	18–28	B22g	102	21	102.0	20.8	5	.44						100	99	96	85	82	73	47	39	50	29	A–7–6(18)	CL.
		7–3	50–60+	C2g	119	14	118.8	13.4	3	−.22				100	98	97	94	88	81	64	60	49	29	24	28	12	A–6(7)	CL.
SE¼SE¼ sec. 25, T. 19 N., R. 7 E. (approaching Kokomo).	Late Wisconsin glacial till.	8–1	0–10	Ap	99	20	99.4	20.1	6	.47						100	99	95	79	75	61	36	25	40	15	A–6(10)	ML–CL.
		8–2	21–33	B22g	105	17	104.5	17.1	6	1.34						100	99	96	87	83	70	46	37	46	24	A–7–6(15)	CL.
		8–3	44–60	C2g	117	15	116.4	15.4	4						100	99	97	93	88	66	60	51	35	27	29	13	A–6(7)	CL.
SW¼SW¼ sec. 13, T. 21 N., R. 6 E. (approaching Mahalasville).	Lacustrine silt and sand over glacial till.	9–1	0–9	Ap	98	22	98.7	21.0	6	.82									100	99	94	92	75	44	35	52	23	A–7–6(13)	MH–CH or CH.
		9–2	17–28	B22g	101	20	102.0	20.3	8	.80									100	98	96	94	81	49	41	58	35	A–7–6(20)	CH.
		9–3	44–60	C2g	125	11	122.7	11.6	7	.3				100	98	95	90	86	77	54	51	40	23	19	23	7	A–4(4)	ML–CL.
Fox silt loam:																										
SE¼NW¼ sec. 11, T. 20 N., R. 6 E. (modal).	Glacial outwash.	2–1	3–11	A2	109	16	109.2	16.3	10	−.07						100	99	98	88	69	65	51	24	16	28	6	A–4(7)	ML–CL.
		2–2	21–29	B22	104	17	106.0	17.7	13	.4				100	96	88	83	76	57	48	48	45	35	30	48	21	A–7–6(7)	SM–SC.
		2–3	29–36	B3	108	13	106.3	15.5	12	.65					100	86	73	63	43	27	27	25	25	24	46	20	A–2–7(1)	SM–SC.
		2–4	36–50+	C	132	10	131.0	9.5	37	−.36				100	95	80	68	55	20	6	5	5	4	4	[5] NP	[5] NP	A–1–b(0)	SW–SM.
NW¼NW¼ sec. 35, T. 19 N., R. 7 E. (approaching Casco).	Glacial outwash.	3–1	2–9	A2	108	16	109.2	16.1	9	.16						100	94	89	84	78	68	67	55	27	20	39	15	A–6(9)	ML–CL.
		3–2	14–20	B22	101	20	101.4	21.2	6	.27				100	80	73	67	53	44	38	38	37	30	28	34	5	A–4(1)	GM.
		3–3	20–26	B3	100	18	98.5	17.3	4	2.76				100	88	78	71	64	55	50	50	46	38	35	52	22	A–7–6(8)	SM–SC.
		3–4	35–50+	C2	136	8	134.2	7.7	70	0	[6] 97	97	87	83	73	55	26	7	5	5	5	3	2	19	4	A–1–a(0)	SW–SM.
SW¼NW¼ sec. 16, T. 19 N., R. 8 E. (approaching Ockley).	Glacial outwash.	1–1	3–11	A2	103	18	103.0	18.1	5	.20						100	96	82	74	54	24	15	32	10	A–4(8)	ML–CL.
		1–2	23–34	B22	110	16	110.1	16.9	5	.11					100	99	95	90	75	58	55	47	39	36	36	16	A–6(7)	CL.
		1–3	34–41	B3	108	16	107.9	15.8	14	.24				100	84	73	64	53	35	26	25	25	23	20	47	19	A–2–7(1)	SM–SC.
		1–4	41–60+	C	127	11	126.6	11.2	20	0		[7] 100	81	75	63	50	28	8	5	5	4	3	2	[5] NP	[5] NP	A–1–a–(0)	GW–GM.
Miami silt loam:																										
SE¼NW¼ sec. 23, T 20 N., R 6 E. (modal).	Late Wisconsin glacial till.	6–1	3–11	A2	98	21	97.1	22.0	2	16						100	99	96	81	77	50	21	15	33	8	A–4(8)	ML–CL.
		6–2	23–34	B22	105	19	104.3	19.6	5	.2					100	99	99	97	94	76	73	63	47	39	37	18	A–6(11)	CL.
		6–3	37–52+	C	118	14	118.1	14.8	5	.22				100	98	97	94	89	87	64	63	53	35	25	30	14	A–6(7)	CL.
SW¼NE¼ sec. 17, T. 18 N., R. 8 E. (approaching Fox).	Late Wisconsin glacial till.	4–1	4–11	A2	98	22	97.6	22.4	2	−.11						100	99	94	85	85	68	33	25	37	11	A–6(8)	ML–CL.
		4–2	19–27	B22	103	20	102.3	20.9	6	.22				100	98	95	92	89	78	60	57	53	43	41	53	31	A–7–6(15)	CH.
		4–3	39–52+	C2	122	12	121.0	12.2	5	.13				100	96	94	91	87	77	60	59	50	30	24	25	10	A–4(5)	CL.
NW¼NW¼ sec. 6, T. 19 N., R. 7 E. (approaching Hennepin).	Late Wisconsin glacial till	5–1	3–8	A2	106	17	107.0	17.6	3	−.29						100	99	98	92	71	71	60	29	23	26	5	A–4–(7)	ML–CL.
		5–2	15–24	B22	104	18	104.5	19.2	6	.49						100	99	97	93	73	71	68	52	43	46	26	A–7–6(15)	CL.
		5–3	30–45+	C2	124	12	123.2	12.3	3	.59					100	93	88	83	76	56	53	44	25	19	23	8	A–4(4)	CL.

[1] Based on AASHO Designation: T 99–57, Method A (*1*).

[2] The soil sample is prepared according to method described in AASHO Designation: T 87–49. Water is added to bring moisture content to within ± 0.5 percent of optimum. Specimens are compacted according to Method B described in AASHO Designation: T 99–57 to within ± 1 lb. per cu. ft. of maximum dry density. A surcharge of 35 lb. is added, and the specimen is soaked from top and bottom for 4 days. The penetration is performed at a rate of 0.05 in. per min. while the 35-lb. surcharge is on the specimen. The CBR value is for 0.1 inch penetration.

[3] Mechanical analyses according to the AASHO Designation: T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

[4] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a border line classification. Examples are MH–CH, ML–CL, SM–SC.

[5] NP = Nonplastic.

[6] An estimated 3 percent was larger than 3 inches and was discarded in field sampling.

[7] Based on sample as received in laboratory. Laboratory test data not corrected for amount discarded in field sampling.

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